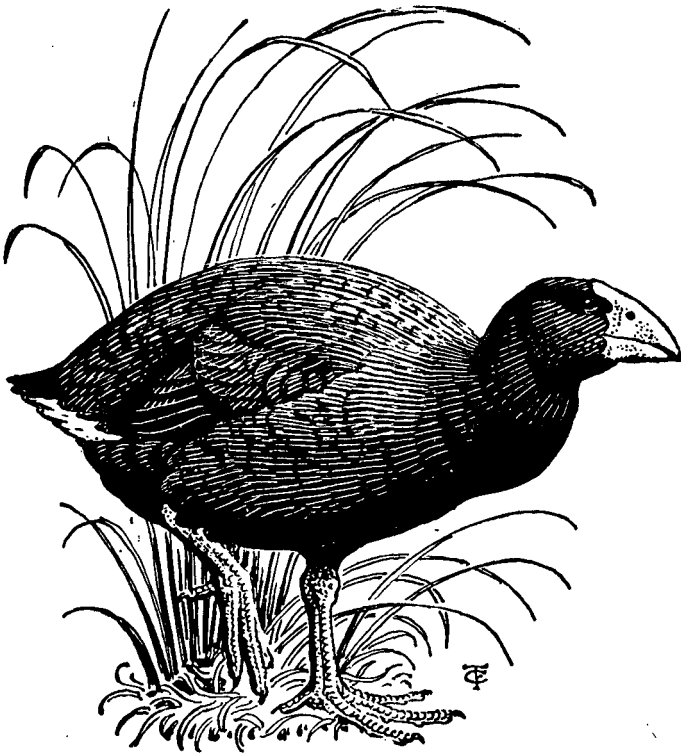


NOTORNIS

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NOTORNIS

In continuation of New Zealand Bird Notes

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NOTORNIS

VOLUME SEVEN NUMBER SIX ; OCTOBER NINETEEN FIFTY-SEVEN

SOME PRELIMINARY DATA ON THE POPULATION DYNAMICS OF THE TAKAHE (*Notornis mantelli*, Owen)

By G. R. WILLIAMS

Wildlife Branch, Department of Internal Affairs

As far as information at present available permits, this paper deals with breeding season data, and particular emphasis is given to clutch size, egg fertility, egg production and chick survival.

Discussion of population size, display, pair formation and various aspects of behaviour will appear elsewhere. I have used the papers of Falla (1949, 1951), Kennedy (1955), Williams (1952, 1955) and Williams and Miers (1957), together with unpublished field notes in preparing the table.

DURATION OF THE BREEDING SEASON

Eggs may be laid as early as the beginning of October and an approximately week-old chick (resulting perhaps from renesting or double brooding) has been seen as late as 31 March. Most of the nest records are for November and December, but this may be a reflexion as much of the peak period of investigation as of the true period of maximum nesting effort. Though a five to six-month breeding season may seem rather long it is matched by that found by Gullion (1954) for the American coot (*Fulica americana*) in California.

BREEDING AGE

We know from two birds banded as chicks that successful breeding may occur in the first season after hatching, but it is not yet known whether this may be taken as the general rule. Banding has also shown (as might in any case have been expected from the previous fact) that at least some birds breed annually. At present there is no reason to doubt that all mature birds will *pair* annually if not already paired, though, as will be seen later, this may not always result in the laying of eggs.

CLUTCH SIZE

This may be either one or two: eggs have been found in 36 nests and there are 20 records of one-egg clutches, but of these (to go to an extreme) we can be quite sure of only seven, for only in these seven instances were observations such that the presence of a second egg at any time can be utterly discounted. Although there are only 16 records of two-egg clutches, what is known of the behaviour of adults when hatching occurs makes it fairly certain that the larger clutch is nevertheless at least as common as the smaller. For example, three instances are known of the second egg of a clutch being deserted after the first had hatched; had these nests been found only *after* desertion a reasonable conclusion might have been reached that they were deserted one-egg clutches — and especially would this have been more likely to have been the opinion when, during the earlier years of the investigation, it was not generally known that the finely broken-up pieces of the hatched egg are usually to be found out of sight beneath the large nest bowl. (Kozicky and Schmidt, 1949, report that the same state of affairs may also occur in nests of the clapper rail, *Rallus obsoletus*, and desertion of part of the clutch has been reported in other rails — for example, by Gullion in the American coot and by Alley and Boyd, 1947, in the European coot, *Fulica atra*.) Furthermore, until late 1952 when opinion became favourable for the beginning of a banding campaign recommended as early as 1949, particular birds

with nests or chicks could not be positively identified — hence some other originally two-egg clutches could have been missed since birds that had hatched one of two eggs could not always be associated with the remaining egg and nest. No three-egg clutches are known — the careful examination of one deserted nest associated with three eggs indicates that two eggs had been laid, incubated and deserted and then one egg laid in the deserted nest bowl (see photograph). Four instances are known of takahe incubating empty nests which seem never to have contained eggs, and in at least one of these instances incubation, which must have lasted between seven and eight weeks (Miers, *pers. comm.*), was being shared, as is usual in this species, by both birds. (It will be shown elsewhere that the incubation time for takahe eggs is approximately four weeks.)

The average clutch size for takahe — lying between one and two — is certainly one of the lowest of any of the *Rallidae*; in fact, a wide but not exhaustive search through the literature readily available (Bent 1926, Cayley 1933, Whistler 1935, Roberts 1940, Witherby *et al.* 1941, Serventy and Whittell 1948, Austin and Kuroda 1953, Oliver 1955) has not disclosed any as low. In itself, of course, this fact is not necessarily significant as far as survival is concerned; however, it is interesting because of the commonly accepted opinion that clutch size in many birds is adapted to the food requirements of the young (Lack, 1954).

FERTILITY

In the past, fears have been expressed about the apparent very low fertility of takahe eggs without it being made very clear which is supposed to have come first — the low fertility or the small population. Knowing more, as we now do, about the fate of eggs and about nesting behaviour the situation no longer seems quite so unfavourable though their fertility may yet prove to be lower than the average of those of other rails. Of the 52 eggs recorded the status or ultimate fate of 40 is known*. Of these, infertile eggs or those in which development had ended at an early stage amounted to 12 (or 30%); those of known fate — destroyed — but unknown fertility made up 5 (or 13%). The remaining 23 (57%) were regarded as actively developing and all but three of these seem to have given rise to *advanced* embryos or chicks. (This figure has been arrived at by adding together live or dead embryos found *in ovo*, live chicks actually seen in the nest or its immediate precincts and, with less justification, chicks reported in the feeding territory surrounding the nest from which hatching is suspected.) So, of the 35 eggs (12 + 23) whose fertility was ascertained — though discrimination between truly infertile eggs and those in which only early development occurred has usually not been made — at least 66% may be regarded as having been fertile, and from these, in turn, 15 birds hatched to leave the nest. How do these figures compare with those given in the literature for some other rails?

In his study of the American coot Gullion found that 24% of 119 eggs laid were 'addled' (by which he apparently means infertile as well as dying early in development). However, there was no information on fertility for 31 of the total number of eggs. Disregarding these, then, the proportion 'addled' when calculated on the remainder (88) is found to be 31%, which means that almost the same percentage (69%) of eggs hatched or gave rise to advanced embryos as has been found for the takahe. That the two calculations agree so well is no doubt fortuitous, but the comparison at least shows that the degree of *apparent* infertility among takahe eggs may not be so very different from that found in one instance for a thriving species. However, Gullion's figures may not be representative. In fact he quotes other workers who found a much higher fertility (at least 90%) for this and other species of rail; and Alley and Boyd, in their study of the European coot, found that 91% of all eggs laid hatched.

*Most, if not all, of the 12 eggs whose individual fates are unknown disappeared without any definite trace or issue between the brief expeditions that were characteristic of the earlier years of the takahe investigation.

A comparison of the degree of fledgling success in the three species would have been of considerable interest. Unfortunately, this will be information exceedingly hard to get for the takahe because of the difficulty of re-locating chicks a short time after they have left the nest and are able to take refuge in the thick cover. We do know from the records of those nests for which there is clutch size data that, calculated from the total number of eggs laid, 29% gave rise to chicks that left the nest, but we have no useful data on subsequent mortality throughout the first year of life. On the basis of assumptions of the extent of this mortality, comparisons with the European and American coots could then be made, but in my opinion, under such conditions, the comparisons would be of little value.

RE-NESTING

Four instances of re-nesting have been recorded. Two of these rely to some extent on circumstantial evidence — an occupied nest in a territory has later been found to be deserted with a new and occupied nest situated very close nearby. In one of these instances egg measurements from the two nests were in excellent agreement (Bell *unpubl.*). On the third occasion a positively identified banded adult was seen with a chick a few days old about ten weeks after having been seen in almost precisely the same place with another chick. Though this earlier chick could not be traced we cannot assume that it was certainly dead for chicks of approximately three months of age are particularly difficult to catch sight of in the tall tussock and low scrub — more so than very much younger chicks which cannot move so easily through the thick cover. (Incidentally, if the incubation time for takahe eggs is about four weeks and the second chick was approximately one week old when first seen, then the second clutch with this particular adult concerned must have been laid at least four weeks after the first had hatched.)

The fourth instance of re-nesting concerns the nest already referred to associated with three eggs. The freshest of these, containing a dead embryo slightly decomposed, lay in the nest bowl; a foot away outside the bowl lay another, slightly cracked but not pipped, which also contained an advanced embryo but noticeably more decomposed than the other; a foot way again in a direct line was the third egg, broken open and empty, and, from the appearance of the shell, about the same age as the second. It did not have the appearance of one from which a chick had hatched. The most satisfactory reconstruction of the history of this nest is that a double desertion from unknown causes had occurred — the first following a two-egg clutch and the second a one-egg clutch. No egg fragments were found in or about the nest bowl which might suggest a second *two*-egg clutch from which one chick had successfully hatched.

CHICK AND ADULT MORTALITY

Nothing definite is known about either of these two population parameters — the chance of finding dead fledglings in the thick cover is remote (only one — unbanded — has been found so far and this was in 1950) and we are not justified in assuming the death of a chick if we are later unable to trace it in an area where it had previously been seen. It is rather more significant that all the expeditions into the main colony over the past eight years have found only two recently-dead adults (unbanded birds in 1949 and 1951), for the birds are large and their remains would be conspicuous except in the thickest cover: and the methods of observations are such as to ensure a fairly full coverage of most of the snow-tussock areas, especially those of the two valley floors which are the dwelling places of most of the population of the main colony. The implication is that the species (once past the fledgling stage, at least) is a relatively long-lived one. In all, 35 takahe have been banded up to January 1957 (though some or all of the five marked in the initial banding of December 1952 with plastic colour bands *only* — Riney and Miers 1956 — and so far untraced, may have since lost these and been unknowingly rebanded with aluminium *and* cemented plastic bands). Of these 35, 16 have been positively identified between one and four years after their first capture (four

years being the theoretical maximum time so far for the earliest-banded birds). Since some of the earlier-banded birds through loss of their colour bands (apart from the five already mentioned) can no longer be identified except by capture and reading of the numbered aluminium band, the number surviving one or more years after banding must be higher than the known total of sixteen. At present, of course, there is insufficient data for the preparation of a reliable life table.

REPLACEMENT RATE

At the present state of knowledge it is impossible to make any estimate of replacement rate that will satisfy all critics; and by 'replacement rate' is meant the rate at which new adults of breeding age are produced; in fact, Lack (1954) has drawn attention to the many difficulties that stand in the way of any accurate calculation of this property, and he lists the criteria needed to make such a calculation. For example, we should need to know at least: (i) the breeding age, (ii) the proportion of non-breeding to breeding adults, (iii) the mean number of broods per breeding female and (iv) fledging success and first year mortality. Now, in the case of the takahe, for example, any estimation of the *proportion* of mated pairs which breed each season must be tentative; this is just another result of the difficulty of observation and of the proper interpretation of behaviour. Thus, we do not know whether birds incubating empty nests ever lay in the same season, but judging from the time some are prepared to sit to no purpose (54 days in one case) it seems unlikely that they will. From the nest records it appears that about 11% of pairs may not breed annually for this reason.) Then again, though we can be reasonably sure from behaviour whether a pair whose nest has not been found is caring for a chick that may be up to a month old, after this age — when it is able to move about more freely — the chick's presence is difficult to establish short of an actual sight record which is not easily obtained.* But the complication arises that this family group may now wander occasionally from what we recognise as its territory and so be counted, if it has not been definitely identified beforehand, as another breeding pair elsewhere; though it must be stated that the species is generally remarkably territorial throughout the year. Furthermore, we cannot estimate (outside of our nest record data) the number of unproductive pairs, for we have no way of being sure whether mated pairs for which no chicks have been found are *really* without chicks or have never laid; nor can any estimate be made at present of the proportion of unmated birds in the population. If we added to the data from our nest record cards, information on pairs with a chick — information not so far included because of the absence of data on the size of the clutch from which the chick must have hatched,§ this would cause a bias suggesting a higher replacement rate than actually exists; for it would be equivalent to assuming that all attempts at raising young outside those included on the nest record cards had been successful, which is absurd; therefore the most satisfactory course of all seems to be to calculate replacement rate from nest records *only* rather than from the number of young produced by all the adults in the main study area (which, incidentally, over all years gives a figure of between 0.5 and 0.7 per pair). From the table we see that there are records of 36 nesting efforts about which we have clutch size data and four of these were the result of re-nesting. Therefore we have a total over all years of 32 effective nesting pairs. To this must be added the four pairs that incubated empty nests. This then raises the total to 36 effective nesting pairs:

36 pairs produced 15 chicks which left the nest.

1 pair, then, produces 0.42 chick per year or, in round figures:

*The seldom-heard call of the partly-grown bird is characteristic, however, and the finding of small fresh droppings (or of tracks accompanying adults) may be taken as fair evidence of its existence.

§One such addition would be the third instance of re-nesting referred to earlier, there are no clutch records of the two nests that must have existed.

1 bird, then, produces 0.20 chick per year to the stage of leaving the nest. With the help of some assumptions and/or approximations we may make a rough preliminary estimate of the life equation for the takahe. The first two of these are (i) that over the last eight years there has been a mean stable population (though the extreme long-term trend may well be towards extinction); and (ii) that the breeding age is one year. Now, working from the quantitative material at our disposal we may say that the maximum replacement rate must be 20% — that is, that *all* chicks leaving the nest survive to breed; and this, of course, means in turn — following upon the assumptions we have made — that the annual adult mortality of birds of one year of age or more must also be 20%. Though there is no useful information of first year mortality we can at least be sure that there is some and that it may be considerable. If only 50% of young birds leaving the nest survive to breed then the replacement rate would be, of course, 10%, as would then be the annual adult mortality. Whatever provisional estimates we may make of first year mortality (and because of the smallness of the population and the difficulty of observation estimates may have to be provisional for a long time yet) it appears that the species must be a long-lived one. For example, an annual adult mortality of 10% implies an average expectation of further life (ex) of between 9 and 10 years if, as in most birds, adult mortality is taken as being independent of age.* Other evidence supports this view: Thus only two adult birds have so far been found dead in the main colony areas and survival among banded birds has been high so far.

POPULATION REGULATION

As far as we can tell the number of takahe in the main colony is notably stable from year to year and pairs can usually be found, no matter what the season, in fairly well defined areas. Because the adults are long-lived and mate perhaps for life, the implication is that chicks unable to find an unoccupied territory or an unmated bird in occupation of one must generally leave the vicinity of the colony. Rather rarely from present evidence they may succeed in establishing a territory in already occupied ground. Thus population regulation seems dependent — in the main colony at least — upon the species' territorial behaviour. However, from observations made in the main colony over a number of years I am convinced that this territorial behaviour does not limit population density through regulation of food supply or cover. Whether or not the takahe *prefer* the shoots or seeds of the snow tussocks on which they feed, these do supply the great bulk of their food and always appear to be growing in superabundance for both food and cover needs in all territories every year. In other words, the size of the territories appears to bear no close relation to the food and cover requirements of the pairs and young inhabiting them. Thus I am in general agreement with Lack (1954) and Hinde (1956) on the particular point that the food value of the territory is not significant in this regard. Regulation comes about merely because year-round occupation of territories by long-lived birds that may mate for life forces the young to move elsewhere. Though a few chicks have been banded there is little chance of recovering them outside the main colony because the nature of the terrain is such that it is seldom visited. The movement of greatest amplitude at present known is however that of a chick which travelled some 2000 yards from the territory in which it was hatched and banded to that in which it bred twelve months later. Other aspects of territorial behaviour are to be dealt with, more properly, in forthcoming publications.

At this point we must stop until the rather slow accretion of information

*Ex (adult) can be readily found from the equation:

$$Ex = \frac{2 - m}{2m} \text{ years}$$

where m = average annual mortality rate independent of age in a population of stable and appropriate age distribution.

makes a re-examination of the whole subject possible. Though it may rightly be maintained that some of what has been said depends upon assumptions and for that reason the paper may be somewhat premature, it has been offered, nevertheless, because really reliable information will take a very long time to obtain, and a statement of some kind is surely due after nearly nine years of even intermittent work on a species of such general interest.

THANKS

In the course of preparing this paper I have had, in addition to my own unpublished field notes, access to unpublished reports furnished the Wildlife Branch by a number of visitors to Takahe Valley. I have tried to acknowledge particular sources of information in the text, but in addition would like to thank the following for making their reports available for consultation: Mr L. C. Bell, Dr D. S. Farner, Mr H. L. Secker, Mr E. G. Turbott, Mr J. S. Watson, Dr K. E. Westerskov and Mr K. H. Miers. I should also like to thank Mr Miers for critically reading the manuscript.

Breeding season	One-egg clutches	Two-egg clutches	Total eggs	Fertile	Infertile or early develop. only	Destroyed & fertility unknown	No details	Re-nesting	Incubated empty nests	Known chicks leaving nests	Chicks surviving elsewhere	Mating pairs elsewhere
1948-49	2	—	2	1	—	—	1	—	—	—	1	1
1949-50	2	3	8	3	3	—	2	—	—	2	—	1
1950-51	1	—	1	—	1	—	—	—	1	—	5	6
1951-52	3	2	7	3	2	—	2	—	1	3	7	9
1952-53	4	3	10	3	2	—	5	1	1	2	5	5
1953-54	2	2	6	2	1	1	2	2	—	1	4	2
1954-55	3	3	9	5	1	3	—	—	1	4	3	5
1955-56	3	3	9	6	2	1	—	1	—	3	—	1
Totals	20	16	52	23	12	5	12	4	4	15	25	30 (31?)

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HEN ISLAND IN WINTER

By B. D. HEATHER

In mid-August 1953, fourteen members of the Auckland University College Field Club visited Taranga (Hen I.). Four O.S.N.Z. members, I. A. Atkinson, B. D. Heather, R. R. Moynihan and C. B. Trevarthen, were present, but, because of other scientific work and two nights and a day of continuous rain, the success, ornithologically, of the five days' visit was small.

The usual boisterous crossings to and from Leigh were made with Mr Norman Warren in the *Gunner*, and we landed in Old Woman Cove on the South Coast. Camp was sited a chain into the bush immediately east of the main stream of the Cove. This afforded a chance of comparing the merits of this and the traditional western site as I experienced it in December 1948. (Sibson, *Notornis* 3: 183-8.)

In summer, the south site should offer a more reliable landing, a central position with quick access to the main ridge once the best route is known, an abundance of water, a minimum of the enervating summer sun, and a good area for all birds.

In winter, however, this site is damp, sunless and chilly. When rain falls, the gullies quickly become raging torrents and water flows, unceasing and unchecked, down the steep, thin-soiled slopes. In fine weather the winter sun scarcely touches these south slopes and birds seem to favour the more equable conditions of the north and west sides.

We would therefore suggest that the south site be used for summer visits and the west site for winter visits.

For accounts of various scientific aspects of Taranga, see *Tane*, journal of the A.U.C.F.C., Vol. 6, 1953-54, an issue of note for students of Northland and Bay of Plenty offshore islands. This includes (pp. 20-25) a full geographical account, with map, of Taranga by G. A. Cochrane.

In the following list, the outward voyage on 17/8/53 is designated 'outward', and the return to Leigh on 23/8/53 as 'inward'.

BLUE PENGUIN

Numerous and vociferous ashore at night. Fresh dropping trails frequent on the coast, but the few holes investigated by day were empty. Outward: 5.

MOLLYMAWK (Sp ?)

Outward: 2 adults.

GIANT PETREL

Outward: 8. Inward: 3.

CAPE PIGEON

Outward: 1.

FLESH-FOOTED SHEARWATER

Outward: 1, possibly 2. Inward: 1 near Taranga.

BULLER'S SHEARWATER

None was seen, despite as careful a watch as sea conditions allowed.

SOOTY SHEARWATER

Outward: 1, possibly 2 (cf. *P. carneipes*).

FLUTTERING SHEARWATER

Very numerous both crossings, especially outward. On the night of 19/8/53 a pair was found cleaning out a burrow in the side of a steep gully above the camp.

NORTH ISLAND ALLIED SHEARWATER (*P. assimilis haurakiensis*)

The burrows of this species were hard to find. Burrows examined by day yielded only the baleful glare of *Pt. macroptera*. By night, *assimilis* could be found, mainly by tracing its distinctive ground call, and pairs seemed to be scattered well apart on Taranga's south slopes. The few burrows seen were deeply tunnelled into steep gully-sides or beneath a tree. Two, though occupied, had neither egg nor chick. However, two eggs were found deserted amid the fern on parts of the main ridge. Mr E. G. Turbott gives the measurements of these, now in the Auckland Museum, as 55.7 x 36.1 mm., and c. 56.5 (end of egg damaged) x 35.8 mm. From these meagre data there can unfortunately be no assessment made of the stage of the species' breeding cycle.

In appearance, *P. assimilis* could scarcely be confused with *P. gavia* on the breeding grounds. Its daintier build, black bill and the attractive blueness of its dark plumage, legs and feet, contrast with the drab brown of *gavia*'s plumage and bill, and the pink of its feet and more robust legs.

The ground call of *assimilis*, equally as loud and harsh as that of *Pt. macroptera*, is very similar in form and pitch to the flight call of *P. gavia*. A call indistinguishable from *gavia*'s was heard very infrequently in the sky every night and was assumed at first to be that of *assimilis*, especially in view of the latter's ground call. However the subsequent discovery of at least one pair of *gavia* already on Taranga left the question undecided. All other flight calls were positively identified as those of *Pt. macroptera*.

GREY-FACED PETREL

Abundant. Its burrows extended from the highest peaks to the boundary of bush and shore. Though rarely reaching the density of, say, *Pt. cooki* on Little Barrier or *P. bulleri* on Poor Knights, its burrows occupied all the good sites. Particularly favoured was the soil at the foot of bluffs, in *Astelia* and flax communities, and among boulders and the roots of big trees. They were thus distributed throughout the lower slopes where either beach or cliff is handy. In higher regions they were confined to the neighbourhood of those peaks, bluffs and rocks which pierce the bush canopy.

Burrows contained all stages from no egg to young in first down, but too few could be examined to give a valid picture of the breeding situation. One egg had just hatched on 13/8/53 and another was hatching on 21/8/53.

The huge evening gathering of petrels off the shore seemed entirely of *macroptera*. As the light failed, the birds, as they began sweeping close over beach and headland, were often in small groups. One such group of five birds landed together on a pebble beach, but, disturbed by the observer, turned and, without 'taxiing', flew straight out again.

Macroptera has two calls in its usual repertoire. A loud, harsh, two-syllabled staccato call uttered in flight and on the ground; and the familiar 'oi' of the Maori which is soft, one-syllabled and inaudible when one is within sound of the surf. This is not uttered on the ground.

WHITE-FACED STORM PETREL

Very numerous both crossings, especially outward, from Pakiri to Sail Rock. Often in groups of up to 10.

DIVING PETREL

As for *P. marina*, save that no grouping was noted.

GANNET

A few adults on both crossings, often off the Taranga coast.

PIED SHAG

The colony in Old Woman Cove was not closely inspected, but young were being fed.

WHITE-THROATED SHAG

One reported once at west landing.

BLACK-BACKED GULL

17th: 1 adult and 1 one-year-old in the Cove. 20th: 1 three-year-old in the Cove. Inward: 1 adult, 1 two-year-old and 1 one-year-old well to sea.

RED-BILLED GULL

Outward: 1 near Sail Rock.

CASPIAN TERN

Two singles and a pair were recorded on different days.

WHITE-FRONTED TERN

Small parties of up to five occasionally seen round the island.

HARRIER

Two, possibly three, present.

N.Z. PIGEON

Seldom seen save on the north side in fine weather when they were very conspicuous. The evening aerial display of summer was seen on the south side once only. One bird was disturbed on the ground.

KAKA

Up to four at once frequently heard and seen in all areas. On two moonless nights they were heard in flight. The population seems unlikely to be much greater than six.

RED-FRONTED PARRAKEET

Infrequently seen or heard by contrast with the apparent large numbers seen in January 1948. They were several times disturbed on the ground.

MOREPORK

Barely noticed in view of the petrel din at night.

KINGFISHER

Recorded in Old Woman Cove and at the east and west ends.

FANTAIL

Very few seemed present in most areas. Often feeding over the rocks at low tide.

PIED TIT

Numerous on the north side; elsewhere inconspicuous. Full call infrequent, often with a trill at the end.

GREY WARBLER

Rarely seen and heard on the north side.

PIPIT

Seen on the south shore from east to west ends. One seen once on a main-ridge outcrop.

BELLBIRD

Very numerous, particularly on north and west sides.

TUI

Numerous, particularly on north side and in the flowering kowhais. Neither Bellbirds or Saddlebacks were seen to give attention to kowhai flowers.

SILVEREYE

Scarce. Noted three times only; one of these a flock of six. Beak, wings and feathers of one found, with *Sideroxylon* seed cases, in a disused rat hole.

SADDLEBACK

From the uncertain evidence of sound and conspicuousness, this appeared by far the commonest diurnal species. Heard from the peaks of the summit and

the main ridge, its call pealed from all parts of the canopy below, and birds were encountered wherever one went. Mostly in parties of two or three, they were spending much time busily examining the trees or vigorously tearing off pohutukawa bark in search of insect life. One bird was seen to feed another repeatedly, once with a large larva, while a third bird took no part in these proceedings.

INTRODUCED BIRDS

Blackbird, Thrush, Hedge Sparrow were noted, mainly on the Manuka-Kanuka slope north of the lighthouse. All were recorded on the south side and Blackbird on the north. Hedge Sparrows were heard in full song.

DOES THE LITTLE TERN (*Sterna albifrons*) REACH NEW ZEALAND?

By H. R. McKENZIE and R. B. SIBSON

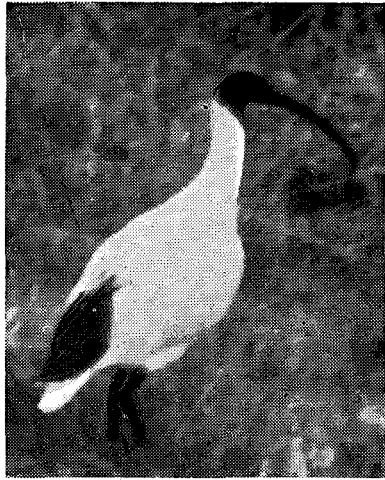
Although we have been visiting the west coast of the Firth of Thames almost monthly since the winter of 1941, it was not till January 1949 that any small terns comparable in size with the Fairy Tern (*S. nereis*) or the Little Tern (*S. albifrons*) were seen. The Fairy Tern is known to be one of the rarest breeding birds in New Zealand, maintaining a precarious hold on one stretch of coast in Northland where the population may not exceed six pairs. Since the Fairy Tern does not breed in the Firth of Thames, it was at first assumed that the small terns which appeared there from time to time were wandering non-breeding birds of this species. When they were distantly seen, the colour of the bill could not be distinguished; when they were seen closely and the bill was seen to be dark and the crown white or mottled, they were thought to be immature Fairy Terns. However, as the number of recorded occurrences increased and we had several opportunities of examining these small terns on the ground at ranges of 20 to 30 yards, we began to find reasons for doubting whether these birds were indeed Fairy Terns. At the time of writing we have not yet been able to identify *Sterna nereis* positively by an all-yellow bill in the Firth of Thames. On the other hand we have on at least four occasions examined in the field small terns apparently in the full adult breeding dress of *S. albifrons*.

These small terns resort to the south-western corner of the Firth of Thames where there are wide mud flats and they can fish in the shallow water along the tideline, especially at the mouths of muddy creeks and rivers, Pukorokoro, Kairito, Waitakaruru and Piako. We have not seen them north of the Miranda beaches and their favourite haunt seems to be near the mouth of the Waitakaruru, which owing to its inaccessibility has not been visited by us nearly as frequently as the rest of the Miranda coast. When big tides force the waders, for the most part Godwits, Knots and Wrybills, to leave Waitakaruru for the Kairito shellbank, at the northern end of what is known to local bird-watchers as 'Wrybill Reach', or the Miranda Lagoon, these small terns habitually go with them, so that their visits to these two well-watched localities as a general rule coincide only with the highest tides.

Since 1949 small terns have been studied with interest in the Firth of Thames by many observers — Mr and Mrs Prickett, Miss N. Macdonald, Miss L. M. Burnside, Miss A. J. Goodwin, Miss M. Sansom, Rev. R. J. Fenton, Rev. W. M. Garner, M. J. S. Black, O. Cheesman, J. C. Davenport, A. G. Gorbey, B. D. Heather, F. Murray, W. W. Renouf, E. G. Turbott, D. A. Urquhart, B. D. Bell and D. H. Brathwaite.

LIST OF REPORTED OCCURRENCES

Date	Number	Place	Observer(s)
31/1/49	2	Piako rivermouth	H.R.McK.
2/12/51	2	Kairito Creek	E.G.T., J.C.D.
15/12/51	1	Waitakaruru	D.A.U.
19/1/52	1	Waitakaruru	H.R.McK., O.C., R.J.F.
22/2/53	3	Pukorokoro Ck.	N.M., R.B.S.



J. PRICKETT, PHOTO



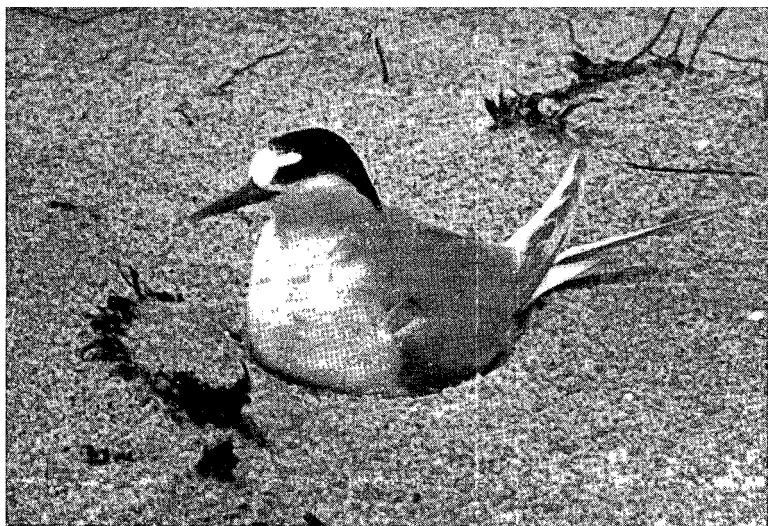
G. R. WILLIAMS, PHOTO

PLATE IX. Top — White Ibis: Kawhia, June 1957.
 Bottom — 'Three-egg' nest of Takahe at head of Point Burn
 Valley, Murchison Range, January 1956.



DR M. F. SOPER, PHOTO

PLATE X. Harrier and chick at nest.



MISS N. MACDONALD, PHOTO

PLATE XI. Top — Fairy Tern on nest: Pakiri, January 1955.
 Bottom — Fairy Tern Chick: Waipu, January 1955.



O. PETERSEN, PHOTO

PLATE XII. Spotted Shag in post-nuptial plumage feeding three-week-old chicks: Bethells, October.

19/3/53	4	Miranda lagoon	H.R.McK.
18/4/53	4	Waitakaruru	H.R.McK., J.C.D., A.J.G.
31/5/53	3	Miranda coast	H.R.McK., W.W.R., L.M.B.
24/11/53	3	Miranda lagoon	R.B.S.
13/12/53	2	Waitakaruru	census
14/11/54	1	Miranda	H.R.McK. et al.
15/1/55	3	Miranda	H.R.McK. et al.
27/2/55	2(?)	Miranda - Waitakaruru	H.R.McK. et al.
26/6/55	1	Waitakaruru	J.C.D. et al.
4/12/55	5	Waitakaruru	J.C.D.
27/12/55	6	Kairito Ck.	N.M., R.B.S.
2/1/56	13	Miranda lagoon	R.B.S., J.C.D., J.P.
3/1/56	11	Miranda lagoon	H.R.McK., L.M.B.
15/1/56	7	Kairito Ck.	R.B.S., D.A.U.
19/2/56	1	Kairito Ck.	R.B.S.
27/2/56	5	Miranda	H.R.McK., M.J.S.B.
21/4/56	11	Kairito Ck.	R.B.S., D. Mills
13/6/56	3	Miranda lagoon	H.R.McK., W.M.G.
17/6/56	1	Kairito Ck.	R.B.S.
25/11/56	7	Waitakaruru	R.B.S.
30/11/56	4	Kairito Ck.	R.B.S. et al.
17/2/57	9	Miranda lagoon	R.B.S., H.R.McK. et al.
/4/57	10	Kairito Ck.	R.B.S., B.D.H. et al.
9/6/57	1	Kairito Ck.	B.D.B., D.H.B.
6/7/57	1	Miranda coast	N.M.

The grouping of these occurrences seems to show that these small terns arrive in the Firth of Thames in November and leave five to seven months later, though one was still present in early July 1957.

DESCRIPTION AND FIELD CHARACTERS

Plumage

The most obvious field character of these terns is their smallness. On 15/1/56 R.B.S. and D.A.U. eventually located seven squatting among Wrybills (*Anarhynchus frontalis*) where at first only three had been visible; and in the air, with their narrow wings and small bodies, they can quickly fade from sight. The tails of those seen between November and February are so short that the name of 'Stump-tailed tern' would not be inappropriate. There is some lengthening of the outer tail feathers in April. In flight they give the impression of being darker on the fore-edge of the wing and in the leading primaries than *S. nereis* when seen on their breeding grounds in Northland. This point of difference is emphatically confirmed by N.M. and A.G.G., who have given much time to the study of Fairy Terns between Pakiri and Ruakaka. All of these terns that have been closely examined between November and January have had dark bills and feet, white foreheads and mottled crowns with more black towards the nape. However between February and June some acquire a plumage which is indistinguishable from that of an adult Little Tern (*S. albigrons*).

On 22/2/53 N.M. and R.B.S. were able to examine three closely as they rested on the mud of Pukorokoro Ck. All three were showing some yellow in the legs; two still had dark bills and smoky 'shoulder' tabs; the third was showing some yellow at the base of the beak. At the time they were assumed to be two immature Fairy Terns and an adult going into winter plumage. However a month later at the same place H.R.McK. found one of four small terns in the full plumage and colouring of an adult *albigrons*, so far as could be ascertained by sight in the field. Notes were taken down while the bird was studied at fifty yards with the aid of a 30x telescope. 'Main part of bill yellow, though a little more orange than the full yellow of Fairy Tern; dark tip to bill, sharply defined at junction with orange-yellow (later found to agree with illustration in *Handbook of British Birds*, Vol. 5, p. 42, and also agreeing as to depth of dark tip); white on forehead less than half-way up to top of crown from bill; dark on "shoulder" and primaries much less than on the others; dark strip or band from under eye to bill; legs reddish- or brownish-yellow, not the full yellow of Fairy Tern'.

In the 1955-1956 season the number of these small terns in the Firth of Thames surpassed all previous records; but it was not till 21/4/56 that a bird in plumage similar to that described by H.R.McK. three years before was

seen. Accompanied by David Mills, son of a Sussex ornithologist, R.B.S. met with eleven small terns at Wrybill Reach. Most that could be examined still had dusky bills, but one which rested conveniently close had a yellow bill with a black tip; and the black on the head passed under the eye right forward to the upper mandible, there being no white gap as in *S. nereis*, as is made clear in photographs by G. A. Buddle, G. J. Moon, Miss N. Macdonald and Mr and Mrs Prickett.

Subsequently further strong evidence in favour of *S. albigrons* was obtained on 13/6/56 at Miranda lagoon by H.R.McK. accompanied by W. M. Garner and L. P. Sladdin. Three birds, studied closely and at leisure, had yellow bills, shaded dark along the lower part, with definite black tip; black low on front of head; dark 'shoulder' patch and primaries; black band forward from eye to bill, feet tan yellow. These birds were not quite as fully into breeding plumage as the one of 19/3/53. One, the smallest, was less advanced, the bill being a little yellow and the black not so far down the forehead. It could well be a link between those in immature or winter dress and those in or near breeding dress.

We have considered the question whether birds which looked like adult *albigrons* with black-tipped bills might not be *nereis* before the change into adult plumage with wholly yellow bill had been completed. There are three strong points against this: (a) the black tip ended sharply without any blurring, (b) the black of the cap came too far forward and made the white of the forehead narrower than it is in *nereis*, (c) the black stripe along the lores reached forward to the bill.

On 25/11/56 R.B.S. had excellent views in clear sunshine of seven small dark-billed terns at the mouth of the Waitakaruru river. They settled on the mud and had to keep moving as the creeping tide pushed them. Three looked like first-year birds with brownish mottling on the wing. The others could have been adults with the black on the head much diminished, or sub-adults, i.e. second-year birds, but in at least one a streak of black ran forward to the bill. The near-black in the primaries was very noticeable. It is difficult to conceive that at this season *S. nereis* could have looked like these birds.

Seasonal occurrences compared with Fairy Tern

The Fairy Tern has for several years been noted to arrive on the North Auckland coast in September, being then in full breeding dress, and to leave by early February, still in full colour. This contrasts strongly with the occurrence of the Little Tern, which is in eclipse plumage almost the whole of the time the Fairy Tern is present in breeding plumage. Frequent patrolling of the northern beaches in winter has not revealed Fairy Tern until 13/7/57, when Mr and Mrs Prickett found and closely studied two at Te Arai with fully yellow bills and feet. This may possibly mean that they, or some of them, do not change colour at all, but it is probable that they lose colour between February and July, just when the Little Tern changes into colour. Immature birds would be likely to confuse the issue.

Voice

A sharp 'kweek' or a rasping 'zweek' is evidently a note of anger or alarm. It was made by each of seven birds as they rose from among Wrybills. Sometimes it is often repeated. H.R.McK. has heard an urgent 'peep, peep, peep' as they hover. They also have a lively pleasant chattering, 'chi-chi chi-chi'.

Behaviour

In the Firth of Thames these small terns are most commonly seen in company with waders. They often fly with and settle among the great flocks of Bar-tailed Godwits and Knots which frequent the Firth from October to April. On 2/1/56 when thirteen small terns were counted, it was not easy to be sure of the exact numbers because while some rested in full view on the edge of the waders, others were out of sight in the middle of them. After January when the Wrybills return, the small terns show a marked preference for resting among them at the full tides. They feed generally along the tidelines, especially near the mouths of creeks. They have a habit of hovering at a height of only three or four feet over the long-legged waders as they stand in

the shallow water, and they may actually dive among the waders to catch their prey.

On 17/2/57 a very high tide of 11ft 8ins was predicted for 9.30 a.m. Accordingly, in expectation that such a brimming tide would cause a great concentration of shore-birds at Miranda, we reached the lagoon about 8 a.m., to find it already crowded with thousands of waders – eventually fourteen species were identified, nine Arctic and five New Zealand breeders – with more continually streaming in from the direction of Piako and Waitakaruru. Mr and Mrs Prickett and B. D. Heather now joined us. Four small terns were quickly spotted as they flew over the resting waders; but although they settled for short periods among Wrybills on the edge of the main pack of Godwits and Knots, they were rather restless and left in a southerly direction. The tide meanwhile was still rising and a few waders were still arriving. We had not waited for long when nine small terns flew in from the direction in which the four had disappeared. For some time they seemed reluctant to settle, but after prospecting some way inland up Pukorokoro Creek, flying rather high, they returned to the northern end of the lagoon where the smaller waders had gathered. Here they settled in the edge of the shallow water among Wrybills, Banded Dotterels and Curlew Sandpipers. As they rested and preened we had ample time to watch them in a good light. One bird was particularly interesting because it appeared to be in the almost complete breeding dress of *S. albifrons*. Its yellow bill had a dark tip and there was only the faintest trace of white between the bill and the black stripe on the lores. In another bird the bill was dark brown with the yellow faintly showing through towards the base; but the loreal stripe already virtually reached the bill. The other seven were obviously in less advanced plumage. They had dark bills and it was easy to see white on the lores between the bill and the forward end of the black ocular stripe.

Another was seen closely on 9/6/57 by B.D.B. and D.H.B. at Kairito Creek. It had a fully yellow bill with the definite black tip, black forward on to forehead almost complete, and the black stripe tapering forward almost to bill.

The latest winter record for these birds was of one seen on the Firth of Thames coast by N.M. on 6/7/57 at 'White Bridge', a little north of Miranda. It had the appearance and flight of the birds already described as being in winter or immature plumage. It was certainly not *Sterna nereis* and was most likely a young Little Tern which was not going to breed in the current season.

These terns often give the impression of being in pairs. On 2/1/56 couples would break away from the resting flock for a few minutes' fishing which was not easy in the teeth of the strong easterly wind. On 21/4/56, when eleven were counted near Kairito Creek, nine were flying overhead at one time and the noise was strongly reminiscent of a colony of *albifrons* in England. Pairs often flew together and after spiralling, the pairs would dive at great speed, the one bird on the tail of the other, calling excitedly. These must have been pair-formation or courtship flights. At a very different season, on 30/11/56, on the same muddy stretch of coast, four small terns split into two couples and became quite agitated overhead, though they could not have had any territorial attachment. The 'zweek' note was used again and again. They also made an excited chittering, very different from the clamour of the White-fronted Terns, which had a breeding colony 200 yards away.

DISCUSSION

We believe that the small terns which we have described are visitors from the northern hemisphere and that they belong to the eastern race (*sinensis*) of the Little Tern, which according to Mayr ranges from the coast of Asia to the New Guinea region and rarely to the Bismarck Archipelago. During the southern summer they are in immature dress or the eclipse plumage of adults; but the assumption of breeding dress between February and June and the decline in their numbers point to a breeding season north of the equator. The dark-billed ones that have been seen in May and June would be non-breeding yearlings, or second year birds; for there are good reasons for believing that

many terns do not breed till their third or fourth year. If these small terns have reached New Zealand from eastern Asia, it is not surprising that many of them should be immature; for it is characteristic of the young of many migratory birds to wander further than the adults and the normal wintering range. Nor is it inconceivable that Asiatic Little Terns should reach New Zealand. The European Little Tern is a vagrant to the coast of South Africa; and a remarkable instance of wandering by the Little Tern has just been published (*The Ring*, p. 144), viz. one ringed as a nestling on 20/3/49 in Java, Indonesia, was recovered on 4/12/52 in Gold Coast, West Africa.

Sterna albigrons is a species with many races, of which those breeding in cooler climates are migratory, while those which breed in or near the tropics are more or less sedentary. It is the common small tern of eastern and northern Australia from which two races *placens* and *tormenti* have been described by Mathews. Little seems to be known about their behaviour; and their validity as subspecies is in question; for they are not mentioned by Alexander, who gives only the subspecific name *sinensis* for Australian Little Terns. *Sterna nereis* is the common small tern of southern and western Australia, and a race has been described from New Caledonia under the name *exsul*. Little has been reported of it. In a key to the South-west Pacific Terns Mayr does not separate immature *albigrons* from immature *nereis*.

If the small terns which have been recorded in the Firth of Thames with increasing frequency are indeed *nereis*, some interesting questions arise. Where do they come from? Where are they being bred? Is there some unknown breeding ground in New Zealand, where *S. nereis* is much more successful than on the east coast of Northland? Miss Macdonald and others who have been studying the few known pairs, report that owing to sandstorms and predators, human and otherwise, very few young have reached the flying stage in recent years, certainly not enough to form a flock of thirteen, or even seven.

The stretch of the Firth of Thames which these small terns favour is very different from the typical habitat of *nereis* in the north, where the few breeding pairs are distributed along a clean, sandy coast, backed by extensive dunes through which at intervals shallow, clear rivers flow into the sea. In the Firth of Thames soft alluvial mud and mangroves are characteristic of the creeks and the outgoing tide exposes a vast acreage of flats. If the terns which we have described are immature Fairy Terns, it is a discovery of some significance, that what by New Zealand standards is a flock of them should resort in their second and probably in their third years to a habitat so very different from their typical breeding place; and it forms an interesting addition to our knowledge of the life history of the Fairy Tern. However, we find it difficult to reconcile our observations of their plumage, moults and behaviour with what is known of the Fairy Tern; and we believe that they are Little Terns of Asiatic, or less likely, of Australian origin.

Outside the Firth of Thames small terns which could not be positively identified as *S. nereis*, and, if the Little Tern is reaching New Zealand, may have been *S. albigrons*, are occasionally reported: e.g., one, dark-billed, at Te Ngaio, Kaipara, seen on 6/1/49 by D. A. Urquhart, B. D. Heather and R.B.S.; one at Puketutu, Manukau, flying with Godwits, seen on 1/3/54 by R.B.S.; one over Maungawhio mudflat at the base of the Mahia Peninsula seen on 19/11/55 by G. E. Sopp and H.R.McK.; one at Harania Creek, Manukau, flying with Knots, seen on 13/3/57 by R.B.S.

THE NESTING OF THE HARRIER

By M. F. SOPER, *Queenstown*

Owing to their extreme timidity at the nest and the readiness with which they will desert if disturbed, continuous observations on any one pair of nesting harriers are not so easily obtained as with most New Zealand birds. The following generalisations are taken from the notes of 15 nests observed for varying periods of time during the course of attempts to establish a photo-

graphic hide. Two nests in particular were very well placed for long range observations in that we were able to look into the nests from the top of a high bank and so get laying dates, egg counts, hatching times and so on without flushing the birds.

Nesting activity starts about mid-September, when birds may be seen indulging in mating flights and carrying nesting material. In this district harriers nest in raupo, bracken, crops, rushes and tussock. The nest is constituted of a base of sticks on which is dumped tussock grass; it is usually an untidy structure and in the middle of the chosen area, not out towards the edge. Building takes about two weeks.

Eggs are laid from early October to late December. They are laid at irregular intervals though usually on alternate days to a normal clutch of five. Three or four eggs are common enough, six or seven more rare. It seems that the hen may start to incubate any time from the laying of the first to the third egg; so hatching extends over several days and in a most irregular manner. Usually two chicks hatch the first day, the third two days later. Further eggs may or may not be laid after incubation has started; there is no fixed rule. However if more than three eggs are laid it is not usual for the last two to hatch, as the harrier usually ceases to incubate soon after the arrival of the third chick. These unhatched eggs I have always found to be fertile and partly incubated. The theory that harriers rely on the body heat of the chicks to hatch the remaining eggs is untenable, as the chicks scramble out of the nest as soon as they are left unattended.

From this it will be seen that harriers are quite irregular in their laying and incubating habits. Our experience has been that no two birds are alike and that all possible combinations and permutations may be met.

The incubation period is somewhere between 31 and 34 days. Harriers sit very close and will not fly off till one is within a few feet of them; in a crop in fact they may sit so close that like pheasants they may get mutilated by crop-cutting machinery.

During incubation and the few days following the first hatch the male brings food to the female, calling her off with a rather high-pitched mewing sound. Prey is carried in one talon and is eaten at a feeding table some 100 yards distant. I have yet to see a male alight at the nest.

In our experience the hen seldom broods the chicks (if at all) once the oldest ones have reached the age of about four days — the youngest will now be about 24 hours old and there may be two unhatched eggs. Once this stage is reached the hen is away the greater part of the day, leaving the chicks unattended. If not hunting she will be perched on a post or on the ground about 100 yards distant and may stay in the one spot for hours at a stretch. The chicks are active and clamber round and out of the nest.

For the first fortnight feeds are approximately four-hourly: early morning, midday, 4 p.m. and dusk (varies with different birds). These times are remarkably constant for a given pair and it would appear that the parents have prey ready to bring in at these times and that it is not brought in as it is obtained.

As with the falcon, the hen does all the feeding of the chicks, but whereas falcon chicks take the pieces of flesh as they are offered, harrier chicks snatch from the parent's beak even before it is properly torn off the carcase; naturally the two biggest get the most. However, falcon chicks are fed at considerably more frequent intervals than harrier chicks so perhaps the latter are ravenous rather than hungry and their behaviour therefore condonable. (But it would never do for a falcon, sir!)

At two weeks they can with difficulty pull pieces off a carcase for themselves. Any part is acceptable and is in fact given from the first day onwards — skin, fur, flesh or entrail. In this district rabbit seems to form their entire diet and I have not managed to recognise any other than rabbit bones round the nest.

At three weeks feeds have dwindled to early morning, midday and dusk; from four weeks to flying often night and morning only.

Wing feathers are obvious at seven days and gradually more feathers come

through till by three weeks they are a sorry mixture of down and feather. At four weeks they are nearly full grown and have little down left. At five weeks they appear fully fledged, though they do not leave the nest till about six weeks.

At all stages they are very active and especially in crops they will be found scattered widely through the corn from about the first week onwards; not necessarily together, in fact often the reverse. They are frequently fed where they stand and not at the nest.

After flight the young continue to use the nest or near vicinity as a roosting place at night for at least two weeks. The hen continues to hunt for her brood during this time.

Finally a hotch-potch of unrelated observations: They will rebuild if their first laying is disturbed or destroyed, and early in incubation they will smash their own eggs. In our experience this second nest is not far removed from their first. Undisturbed, they may use the same nest for a number of seasons, or alternate between two nests. They will desert from the most minor interference and the mere fact of walking up to a nest to examine it and confirm its presence may be sufficient in the early stages. Yet, incredibly, they will allow a crop to be cut about their ears without deserting (chicks), and it is possible to shift a nest, found while harvesting, to the edge of the field, and the hen will continue to feed her chicks in this new situation. (But note here the fact that the chicks wander a lot and are normally frequently fed away from the nest, so that this could be explained as an exaggeration of a normal situation.) They will desert chicks as readily as eggs should they be flushed from the nest. This gives the secret of handling harriers — provided the nest is only visited when the bird is away of her own free will there is virtually no desertion risk; they will usually tolerate being flushed once, while four times seems to be the maximum. Anybody wishing to get information on laying intervals and times of commencing incubation would be wise to watch this. Of our own nests we caused desertion in five; we successfully got a hide up to three; the remainder we left as little disturbed as possible, making no attempt to introduce a hide. Of our desertions, one was caused merely by finding and walking up to the nest, two were caused by hides and two by occupied hides: that is to say, the hides had been successfully brought up to the nest and were accepted by the birds while empty, but the day one of us was left in the hide the birds deserted. We use a heavy grade completely opaque material and so we can confidently rule out the possibility of being seen. We suspect the birds have a 'sense of presence'. Ducks are the same, particularly Shovellers.

MORTALITY AMONG NESTING MUTTONBIRDS NEAR GREYMOUTH

By J. R. JACKSON

During the 1955-56 nesting season several visits were made to colonies of Muttonbirds (*Puffinus griseus*) at Perpendicular Point, Punakaiki and at Twelve Mile Bluff, 12 miles from Greymouth, and in the 1956-57 season the colony at One-One, Hari-Hari, was visited as well.

The colony at Perpendicular Point was formerly very large, and Mr Fischer, who has known the birds for over thirty years, remembers that a stretch of six hundred yards along the cliff used to be riddled with burrows. Even five years ago some burrows remained on the way down to the first cave, but few signs of these now remain. However in 1955-56 at least seven nests and burrows were occupied under or beside the big limestone blocks at the furthest point. The many bleached bones give evidence of the much larger colony in former years. On 4/12/55 at sunset some thirty muttonbirds were flying close inshore and again on 18 and 21/1/55 they were seen in lesser numbers. In February Mr Fischer found two dead birds and a deserted egg. On 12/2/56 no birds were observed overnight nor on the night of 3/3/56. Three more corpses were found. The corpses were found by the more open and accessible nests, perhaps the least favoured nest sites.

On 14/10/56 one burrow was occupied and many had been investigated by the birds. One bird was seen flying at sunset. On 24/11/56 no birds were found and droppings were few and some days old. On the morning of 27/12/56 at least twenty birds left and similarly on the nights of 10/1/57 and 15/1/57 birds returned and departed next morning. On 15/1/57 when a returning bird entered a burrow, welcoming noises from the brooding bird and sometimes a different call, perhaps from the chick, were heard, and so four inaccessible nests were pinpointed. Three birds were caught and examined. They appeared healthy. No corpses were found this season.

Perhaps fifty yards from where burrows were thirty years ago is a cave, containing a Maori midden, and on the cliffs under the burrows nest Spotted Shags (*Stictocarbo punctatus*). In the midden twenty bird bones have been found. These are mainly of the Spotted Shag and none are of the muttonbird.

On top of Twelve Mile Bluff thirty burrows are located in a quarter-acre patch of kiekie (*Freycinetia banksii*) near the cliff top. On 4/12/55 two birds were seen in their burrows, and there were many empty burrows, some obviously having been unoccupied for several years. No trace of old burrows could be found under the nearby second growth, mainly gorse, blackberry and bracken, though before the bluff was cleared, 17 or more years ago, to make what is now called 'Starvation Paddock', muttonbirds were often heard calling by the occupants of nearby houses. A further brief visit was made on 18/12/55, but no birds were seen and the colony appeared deserted. A more careful inspection was undertaken on 22/12/55, when three dead birds were found; two in their burrows and one at the bottom of a runway to the cliff top. No birds had returned to the colony by 10 p.m. On 21/1/56 the colony was visited at midnight and within an hour at least six birds were heard calling. Next morning an occupied burrow was found and three eggs in others, all apparently deserted; another corpse was found. On 12/2/56 the sitting bird and the eggs had gone. Two more birds were found sitting, but they were not disturbed. At least six more corpses were found. A final visit was made on 3/3/56 when the colony was deserted and no birds returned.

In the 1956-57 season during the night of 6/10/56 at least four birds were calling and droppings were found by three burrows. The birds were quiet and very shy, so immediately they heard movement through the kiekie they were silent. The burrows when examined on 24/11/56 were empty, though a corpse was found. Later three more corpses were found in the colony and one on a beach two miles north. Overnight on 21/12/56 no life was heard, but fresh droppings and a broken eggshell with no sign of incubation were found. On 1/1/57 one bird returned and one left next morning, but no occupied burrow could be found, nor on 10/1/57 nor on 15/1/57.

At One-One, at the mouth of the Wanganui River, on the very summit on the inside face, are 16 burrows. Half have not been used for some years and the other half had been investigated by the birds, fresh droppings were around, but none occupied on 9/12/55. One bird was seen flying at sunset on 8/12/56. Here virgin bush remains around the burrows, so human interference can have been only a minor factor in the few birds returning to the colony.

The number of birds found dead during the 1955-56 season seems large in proportion to the small number of breeding pairs thought to be present, and it would be interesting to know the reasons for the mortality. Such information might explain the decline which has occurred during the last forty years in the number of muttonbirds breeding at Perpendicular Point and might even throw some light on the much wider problem of the disappearance of the colonies of muttonbirds and petrels which used to exist in many mainland localities in both North and South Islands.

Unfortunately all the dead birds were in an advanced state of decay, so the cause of death remains uncertain. The bodies showed no signs of having been damaged by animals, such as cats, but it is doubtful if an attack by a stoat could be recognised in such material. Virus diseases have been recorded in shearwaters overseas — e.g. in the Manx Shearwater (*P. puffinus*) (Miles and Stoker, 1948) and in the Bass Strait muttonbirds (*P. tenuirostris*) (pers.

comm.) — and this might provide an explanation for the mortality observed near Greymouth. Certainly the hypothesis is worth testing if fresh materials can be obtained. It is possible that the mortality was increased by a failure of the food supply, and in this connection it is of interest to report that 1955-56 was an unsuccessful breeding season for certain other sea-birds in the district.

In colonies of White-fronted Terns (*Sterna striata*) on a Twelve Mile Island and at the Pancake Rocks, Punakaiki, the eggs were all deserted, and Spotted Shags at Perpendicular Point appeared to raise fewer young than usual.

The disappearance of all birds early in the season and their reappearance later parallels what has been found in Australia where a pair establishes a burrow as its territory, leaves it for a fortnight and returns to lay and to incubate.

I have to thank Mr P. C. Bull for help in the preparation of this paper.

WHITE-FACED HERONS BREEDING IN NORTH AUCKLAND

By F. P. HUDSON

A big dead kauri tree stands on a point of the Kaitoto Creek (Lower Kourawhero) near my house. This tree seems to be a resting place for various strange birds on a flight route from coast to coast — up the Mahurangi River, across the low watershed and down the Hoteo River. In the early autumn of 1956 I saw five herons in this tree and with the aid of binoculars I was able to identify them. They were the first I had seen and were definitely the White-faced Heron (*Notophox novaehollandiae*). They lived up and down the creek and could be seen in open paddocks feeding. Sometimes they roosted in the heads of large totara trees, after a scuffle with the local bunch of magpies. When flying high and purposefully they often gave three loud long croaks, but when flying and playing about the roost tree they gave frequent short croaks.

About the middle of June two would roost here and the other three would continue down the creek. The two broke away from the others in a peculiar manner. Directly over the perch one would turn left, the other right, and each would make a perfect circle about ten chains in diameter and land simultaneously. On June 29 at about 7.45 a.m. I noticed one carrying sticks up into a tall pine tree while the other bird stood in the beginnings of a nest. The height was 47 feet from the ground. The gathering of each load consisted of a glide down of two chains, a minute spent looking for worms, a quick run to pick up a stick, and a slow climb, with neck outstretched, to a limb near the nest, a pause, then a short flight to the base of the long sloping limb, up which the bird flapped with considerable effort to its mate. This went on for one to two hours every morning for about a week. During the day they were away.

On 6 July I noticed one was sitting, and the flimsy nest was never left unattended from then. The other bird would leave about 8 a.m. and return just after sunset with three loud hoarse croaks and then stand on the nest. After two or three minutes one would fly down and hunt worms till dark. I expect that this would be the cock bird relieving the hen to let her get some food. I felt sure she had eggs. The first few days when she stood up to stretch and turn round she was very interested in something between her feet. She was very quiet and did not mind my being under the tree. On 21 July the nest was left for the first time and for all day. The next morning she was back and she sat closely until 4 August, when she flew away and did not return. A. G. Gorbey came from Wellsford and made the difficult climb to the nest. There he found only a few bits of eggshell. On the ground below the nest was more shell and a small dead chick. The eyes of the chick had been open, but it looked pretty helpless. There was some down on it, but the skin was thin. I would think that this nest was a natural failure. There was no sign of interference.

On Sunday 22 July two other White-faced Herons, one considerably faded, sat all day on a limb directly above the nest of the first pair and 16 feet further up. They showed little alarm when I passed the foot of the tree. All day they make a 'Quock-quock-quock' sound to each other like an owl when shifting from foot to foot. It was the only time I heard that particular call.

On Monday morning they spent several hours building a nest. This process was similar to the first except that the carrier would appear to tire after three or four trips and would stand around until the builder came down to hurry him up. They worked each morning and fed during the afternoon for four days, but had by then not built much of a structure. At times work would stop in favour of a general fly around, when they often settled in the dead kauri tree. A third bird would join in these games of 'chase and croak' and enjoy the excitement. In the building of each nest the bird gathering material collected all of it from a small area about a chain long by half a chain wide in line with the nest site and two to three chains from it. The material in the first nest consisted entirely of dry totara twigs from 6 to 18 inches long. The second pair chose a mixture of totara twigs and dead *paspalum* stalks about a foot in length. These herons vary considerably in colour and normally have pink legs, but when the faded-looking pale one flew low over me I saw it had yellow legs, the colour of buttercup flowers. It was the male bird.

The third bird I think by its darker colouring was one of the first pair. It was clearly seen while sitting on a pine branch about 45 feet up. The legs were a pink or mud colour, depending on the light, while the beak was black in the shade and fawn in the sunlight. It had the ability to fluff out the purplish down-like feathers on the sides of the neck from half-way up to three-quarters up. There were none noticeable on the front and I could not see the back. This had the effect of almost doubling the size of that part of the neck. After a few minutes of this (bad temper?) its head sank to the position of a kingfisher's and it waited until I went away.

The nest was finished on 2 August and when we were examining the first one on 5 August our noise did not scare her off, except that she got out of the nest for a while and stood a few inches away where she could see us better.

On 29 August at 10 p.m. there was an unexplained commotion at or near the nest. Next morning I found a hatched eggshell on the ground. There were two more in the next few days. The hen still sat tightly, no doubt brooding small chicks. On 13 September I found a dead chick about one and a half chains up the pine row. It had been dead for some days but appeared to be intact and was in a crouching position as though it fell out and walked until overcome by cold.

On 22 September the hen bird was away for the first time and two small downy heads poked over the side of the nest. I did not see the hen on the nest again except during the continuous thunder on the 24th, the day of a cloudburst. These two small heads were always side by side and always moved as one with perfect timing regardless of what position they happened to be in. By 7 October they had grown very quickly to about the size of a magpie, minus the tail. They seldom sat in the nest now, but walked all over the limb from the trunk to the tip. Every few minutes they stood erect and flapped their wings, which looked to be about full-sized. Often they would jump from twig to twig and sway most dangerously. Sitting still, they were hard to tell from a Kookaburra except for a thinner bill, which was then about half the length of that of the adults. Breast on, with the head tucked in, they were marked very like a native pigeon, the belly being creamy fawn instead of white and the breast and neck olive green with a pinkish tinge in the sun. The wings were perhaps a little more blue than those of the parents, the sides of the neck and head cream with ragged tufts of wind-ruffled down which sometimes blew forward over their faces in a quaint manner. The bills were black and legs dirty-white. They were not fed during the day or evening. I waited from 5.30 to 6.50 p.m. at a safe distance, but the hen was feeding up the flat and never came near. The parrakeets roosted, then the magpies

and an owl awoke, but the hen continued to feed as she did all day. The young were evidently fed before 7.30 a.m. The old hen was becoming tamer. She allowed me within a chain sometimes and I have seen her walk under a cow. Whenever I put her up she flew past the nest for a look and settled elsewhere. The magpies sometimes chased her, but she took little notice and they gave up in disgust. They also had a look at the chicks, who, thinking it was mother with a worm, advanced so readily that they scared the intruders off. While the hen was on the nest the cock could usually be found up the gully looking for worms or some of the multitude of small eels, but after she stopped sitting I did not see a sign of him.

The two young birds reached the ground on 14 October. One worked his way down, a limb at a time, over two days, and the other must have jumped. Their nest was 63 feet up in a rather sparsely branched *Pinus radiata*, one in a single row along a ditch. I did not see the young herons make their first flights, but was in time to see them flapping slowly around in chain-wide circles a few feet up. Landings were generally intended to be on stumps, posts or trees, but mostly they finished on the grass or in the creek. Quite often one would try to settle on a post already occupied by its fellow.

The old bird spent the day on a spur of a nearby hill, flying down now and then for a close look and then going back to her vantage point. That night, the first away from the nest tree, they slept together in a small scrubby willow. They spent several days about the flat feeding on worms and roosting on a low shady totara limb during the heat of the day. They allowed me within 20 feet and if frightened away returned soon after I had gone. By 7 November they kept company less closely, often being chains apart. They had now thinned down and were hard to tell from the old birds except that there was less white on their faces and the blue was a shade darker. Their bills had grown to full length. They spent the days hunting frogs in a lagoon. An old bird visited occasionally, but never stayed long.

At this time there were three other herons working up and down the Kaitoto Creek and sometimes they could be seen resting on the dead kauri. The young birds remained on the farm until the end of November, when they and the older ones disappeared as the ground dried up.

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NEW MEMBERS who have joined since the list published at end of Vol. 6 was compiled:

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